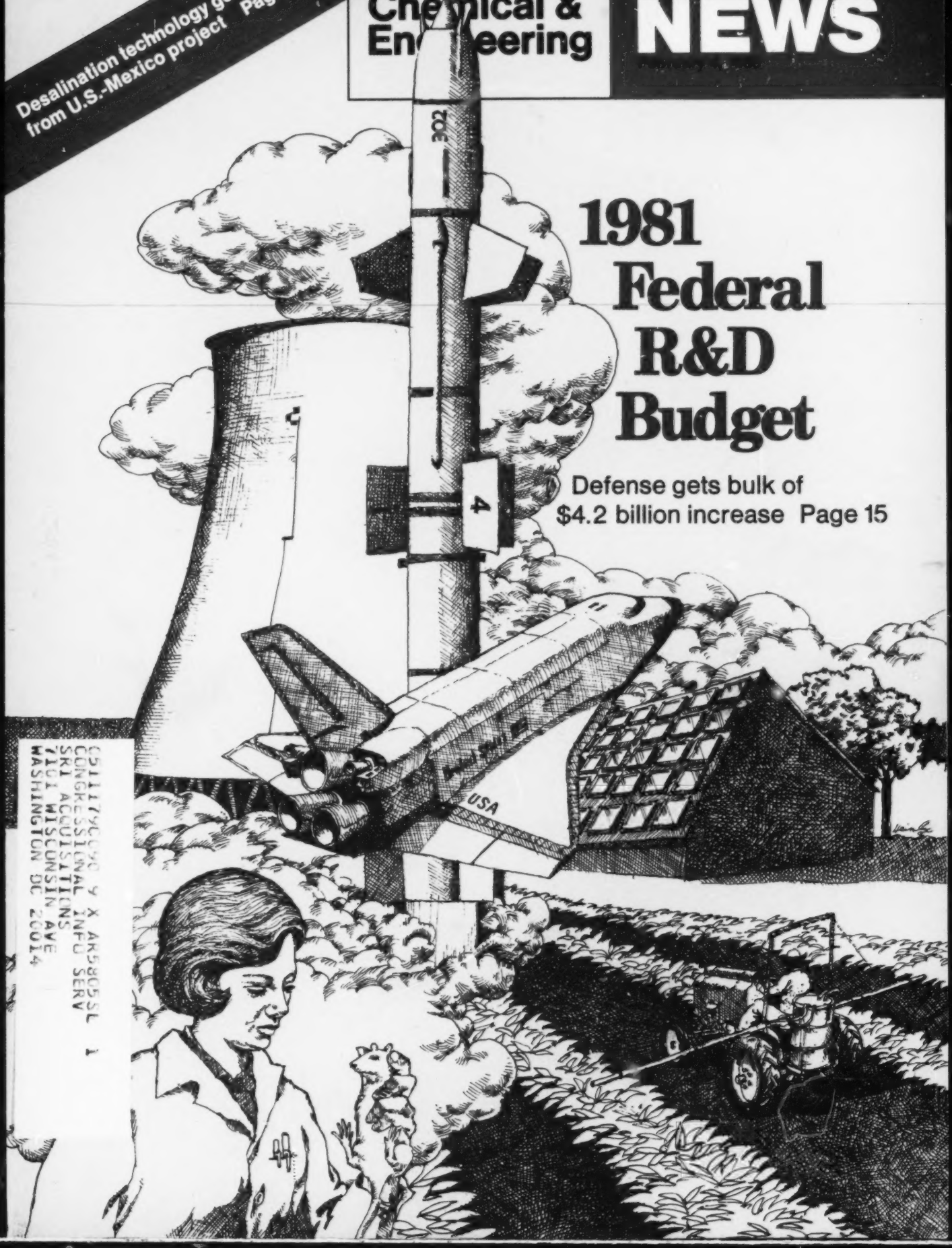
Chemical & Engineering NEWS

Desalination technology gets boost from U.S.-Mexico project Page 26



1981 Federal R&D Budget

Defense gets bulk of $4.2 billion increase Page 15

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- ***Reactions to exile of Soviet scientist*** *Andrei Sakharov include protests from many organizations suggesting a boycott of U.S.-U.S.S.R. scientific exchanges.* ***Page 6***
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Business

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Education

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Brazil seeks self-sufficiency in styrene

With demand to hit 375,000 metric tons by 1985, Brazil plans to hike capacity for monomer substantially, cut down dependence on imports

Brazil is working hard to get its styrene house in order.

Styrene demand this year probably will reach 200,000 metric tons, up 105% from what it was in 1974. And, with demand expected to rise to 375,000 metric tons by 1985, Brazil is putting in huge new chunks of styrene capacity and adding new plants to produce ethylbenzene, styrene's raw material.

Behind the country's capacity buildup is its desire to cut down on imports and become self-sufficient in styrene and ethylbenzene.

Until late 1977, Cia. Brasileira de Estireno (Brazilian Styrene) was the country's only styrene producer. But the firm's 70,000 metric-ton-per-year plant at São Paulo couldn't come close to meeting demand. In 1976, Brazilian Styrene produced 62,000 metric tons and in 1977 64,000 metric tons. But Brazil still had to import 65,000 metric tons in 1976 and 50,000 metric tons the next year to meet the country's thirst for styrene.

In December 1977, Petroflex Ind. e Comércio put its 60,000 metric-ton-per-year styrene unit on stream near Rio de Janeiro, but it couldn't contribute anything to Brazil's styrene production until the following year. Meanwhile, in 1978, Estireno do Nordeste (Northeast Styrene) also put on stream its huge 100,000 metric-ton-per-year styrene unit at Brazil's mammoth Second Petrochemical Pole in Camacari, Bahia.

With Petroflex on stream for the full year and Northeast Styrene on stream for at least part of the year, styrene production jumped to 145,000 metric tons in 1978, more than double what it was the year before. Styrene imports dropped to 10,000 metric tons in 1978, compared to 50,000 metric tons in 1977. And Brazil even managed to export 8000 metric tons of styrene.

Last year, Brazil produced about 176,000 metric tons of its own styrene. That's almost 20% more than the year before, but still only a relatively low 76% of its installed nameplate capacity.

But last year wasn't a smooth one for Brazil's three styrene producers. Operating problems plagued some plants. And, with benzene supply tight last year, producers couldn't get all of the benzene they wanted to operate their ethylbenzene units.

As a result, Brazil wasn't able to eliminate completely its need to import styrene. Last year, an estimated 6000 metric tons of styrene was shipped into the country, not much less than in 1978 before Northeast Styrene's 100,000-metric-ton plant became fully effective.

Actually, Brazil probably won't eliminate styrene imports completely, at least for several more years. Several polystyrene producers have government permission to import small amounts of styrene under a drawback arrangement.

But, faced with a styrene demand that is expected to grow 11% per year over the next five years, Brazil fully intends to keep styrene imports as low as possible. Another huge styrene unit already is in the works.

This will be a 125,000 metric-ton-per-year unit that will be built by Oxiteno do Sul as part of Brazil's Third Petrochemical Pole being constructed at Rio Grande do Sul in southern Brazil. Oxiteno's plant will produce styrene along with 50,000 metric tons per year of propylene oxide using Oxirane technology.

For Oxiteno, this will be its first venture into styrene. The company's expertise lies in ethylene oxide, various glycols, and ethers. Several other companies would have liked to build Brazil's next styrene plant, among them Brazilian Styrene and Dow Chemical, which produces polystyrene there. But in Brazil, the government calls the shots and it opted for Oxirane's proposal, presumably because it filled a need for both styrene and propylene oxide.

The Oxiteno unit originally was scheduled to come on stream in 1982. Now, it has been delayed until 1985. If, indeed, the plant isn't operating until 1985, Brazil will be forced to start importing large volumes of styrene again in 1982. Capacity will remain at 230,000 metric tons, but demand in 1982 probably will be about 260,000 metric tons.

And even with the Oxiteno unit on stream, Brazil will need more styrene capacity by 1985. Demand by then will reach 375,000 metric tons and capacity, even with the Oxiteno unit, will only be 355,000 metric tons. There seems little doubt that styrene plant expansions or another new unit is in the cards for Brazil.

The only benefit to come from the delay in building Oxiteno's plant will be a temporary solution to Brazil's ethylbenzene problem. Until 1978, Brazilian Styrene was the country's only ethylbenzene producer. It supplied almost all—but not completely

Brazilian styrene capacity is growing . . .

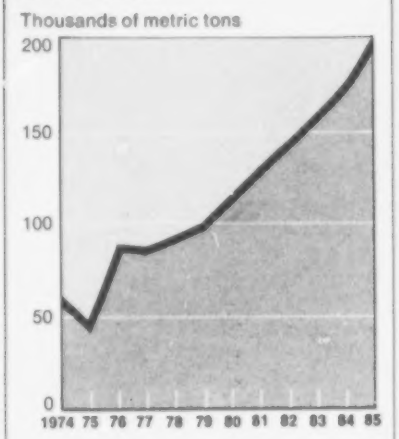
Thousands of metric tons	1976	1977	1978	1979	1980	1981	1982
Cia. Brasileira de Estireno	70	70	70	70	70	70	70
Petroflex Ind. e Comércio		60	60	60	60	60	60
Estireno do Nordeste			100	100	100	100	100
Oxiteno do Sul							125[a]
TOTAL	70	130	230	230	230	230	355

. . . while ethylbenzene capacity tries to keep pace

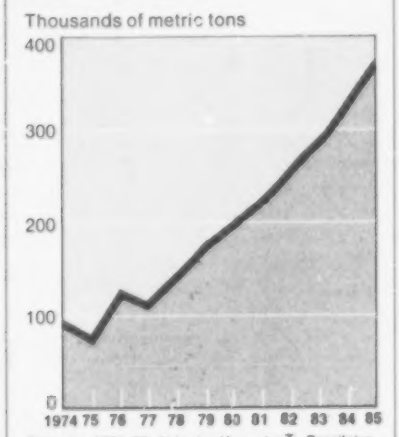
Thousands of metric tons	1976	1977	1978	1979	1980	1981	1982
Cia. Brasileira de Estireno	70	70	70	70	70	70	70
Estireno do Nordeste			110	110	110	110	110
Petroflex Ind. e Comércio							150
TOTAL	70	70	180	180	180	180	330

a May be delayed until 1985. Source: Associação Brasileira da Industria e de Produtos Derivados (Abiquim)

Brazilian polystyrene demand...



...will help spur increased use of styrene



Sources: 1974–78, Abiquim (Associação Brasileira da Indústria Química e de Produtos Derivados); 1979–85, C&EN estimates

all—of its own ethylbenzene requirements.

Petroflex has no captive ethylbenzene. Northeast Styrene has a 110,000 metric-ton-per-year ethylbenzene unit to go along with its styrene plant at Camacari. Last year, Northeast Styrene was able to supply some of Petroflex' ethylbenzene, but an estimated 40,000 metric tons of the raw material still had to be imported.

In 1982, Petroflex is scheduled to put on stream a 150,000-metric-ton ethylbenzene unit at Rio Grande do Sul. This was to supply Oxiteno's styrene-propylene oxide plant. But, if Oxiteno delays its plant until 1985, the Petroflex ethylbenzene unit will be able to supply its own requirements at Rio, at least for a few years. After that, Brazil will be looking for more ethylbenzene capacity to go along with its styrene.

Earl Anderson, C&EN New York

CHECKOFF

NEW PLANTS

■ **Canada**—Cyanamid Americas/Far East part of American Cyanamid plans $19 million, 50,000 metric-ton-per-year calcium carbide expansion at Niagara Falls, Ont., to be completed in 1981, doubling capacity. Product will go to steel industry in desulfurizing reagents.

■ **Chile**—Empresa Nacional de Explosivos S.A. of Santiago has awarded contract to Davy International, West German unit of Davy Corp. of U.K., and to Ingeniera y Construccion Sigdo Koppers of Chile for $25 million, 150 metric-ton-per-day (54,800 metric tons per year) ammonium nitrate plant at Mejelliones on north coast. Startup is planned for beginning of 1982.

■ **Finland**—Kemira Oy of Helsinki has ordered fourth nitric acid plant at Uusikaupunki on Baltic Coast from Uhde GmbH, part of West Germany's Hoechst; capacity will be 400 metric tons per day (146,000 metric tons per year) using Uhde medium-pressure process. On-stream target date is third-quarter 1981.

■ **France**—Du Pont has purchased 37-acre site in Besançon, about 30 miles from Swiss border, for more than $20 million investment, including plant to produce Berg electrical-electronic connectors for data processing and other markets; completion expected in 1981.

■ **Japan**—Sumitomo Chemical is building plant at Chiba complex for 5000 metric tons per year (11 million lb per year) of resorcinol and 2000 metric tons per year (4.4 million lb per year) of hydroquinone; completion targeted for fall 1980. Technology will be new hydroperoxide process based on benzene and propylene.

■ **Portugal**—Uhde GmbH of West Germany has contract to build two 360 metric-ton-per-day (131,400 metric tons per year) nitric acid plants for Messrs. Quimigal of Lisbon, state-owned chemical producer, at Alverca and Lavradio near Lisbon. Plants will use Uhde's dual-pressure process.

■ **South Africa**—Fluor will take part in $30 million contract to build plant to convert creosote-rich coal tars into transport fuels for Sasol Three (Pty.) Ltd. at Secunda in eastern Transvaal. Fuel capacity will be 8000 bbl per day at Sasol Two and Three coal-to-liquids complexes that Fluor is building. Creosote plant will be first of its kind, a type which could be used in U.S., says Fluor. Completion scheduled for mid-1982.

■ **West Germany**—W. R. Grace is building paper chemicals plant in Worms to come on stream at end of third-quarter 1980. Specialty products will include wet-strength resins and synthetic surface and bulk sizing materials. Company also has initial plans without further detail for European facility to produce fluid-cracking catalysts for oil refineries worldwide.

PLANTS COMPLETED

■ **Colombia**—PQ Corp.'s Colombian affiliate, Productos Quimicos Panamericanos of Medellin, has brought on stream second aluminum sulfate plant in Barranquilla, increasing capacity there to 40,000 metric tons per year.

■ **India**—Montedison's engineering arm, Tecnimont, has started up 1000 metric-ton-per-day (365,000 metric tons per year) urea plant in Sindri, about 140 miles northwest of Calcutta. Plant owner is Fertilizer Corp. of India.

■ **Norway**—Norpolefin's new 60,000 metric-ton-per-year (132 million lb per year) high-density polyethylene plant at Bamble started up successfully in second half of 1979, says Saga Petrokjemi, which manages plant. First HDPE plant in Norway, Bamble unit uses Phillips Petroleum technology to make resin from ethylene derived from natural gas liquids from North Sea.

■ **U.K.**—British Industrial Plastics, part of Turner & Newall, has completed 50,000 metric-ton-per-year (110 million lb per year) polyvinyl chloride suspension resin plant at Aycliffe in northern England. Technology is on license from B. F. Goodrich.

R&D spending rise outpaces that of total federal budget

Spending for R&D activities would be up 13%, for basic research up 12% in a fiscal 1981 federal budget that would rise only 9% overall

Janice R. Long, Lois R. Ember, and David J. Hanson
C&EN, Washington

"Austere, prudent, responsible, restrained" were the words being used by federal officials to describe the fiscal 1981 budget proposal unveiled late last month. But for once a tight federal budget doesn't mean bad news for the research community. Instead, the budget proposal bears out President Carter's oft-repeated message of support for science and technology.

Federal outlays are expected to rise only 9% to $615.8 billion. Inasmuch as the Administration is predicting a 9% inflation rate in fiscal 1981, the budget is virtually level with fiscal 1980 spending. The deficit would be held to $15.8 billion, the lowest level in seven years.

Total federal R&D obligations, however, would be up 13%, or $4.2 billion, to $36.1 billion and outlays would be up 11% or $3.2 billion, to $33.7 billion. Both would at least keep up with inflation and the Administration predicts that the increases will allow for real growth. The largest increases are slated for the Department of Defense, 21%, and the National Science Foundation, 17%.

Following the trend in recent years, basic research will continue to do quite well. Under the proposed budget, basic research obligations would be up 12% to $5.1 billion, following a 10% rise in fiscal 1980. Outlays would rise 11.8%, the same rate as in fiscal 1980, to $4.7 billion. Between 1978 and 1981 the basic research budget will have risen some 40%, according to Administration figures, allowing 9% real growth.

Not quite keeping up with the overall rise in federal R&D obligations is R&D support for colleges and universities, which is budgeted to rise 9.5%, or $397 million, to $4.6 billion. About 50% of these funds would go for basic research, about one third for applied research (primarily medical), and the remainder for development activities. And Presidential Science Adviser Frank Press believes that this figure is a bit low—he expects an increase closer to 12%—because of underestimated spending by the Department of Defense for new university research programs. Budget documents show an increase of 10% in DOD's support of university research; Press says the increase will be closer to 25%.

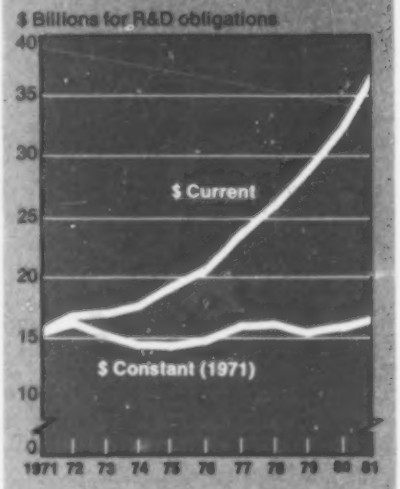
Going counter to the upward trend, obligations for constructing or renovating R&D facilities, acquiring major equipment items, and building and operating demonstration plants would decrease slightly—$23 million, or 1.6%—to about $2 billion. This decrease is perhaps partly explained by the 43.7% increase in obligations for this category in fiscal 1980.

A breakdown of R&D funding by agency finds DOD with about the same large slice of the federal R&D pie as in previous years, 46%. However, DOD's R&D obligations are scheduled to rise a whopping 21%, or $2.9 billion, to a total of $16.6 billion in fiscal 1981. Still the research, development, testing, and evaluation budget proposed for 1981 would amount to only 10.4% of the entire DOD budget, a slight increase from last year. Basic research funding by DOD also would rise more than 20%, up $92 million to $523 million.

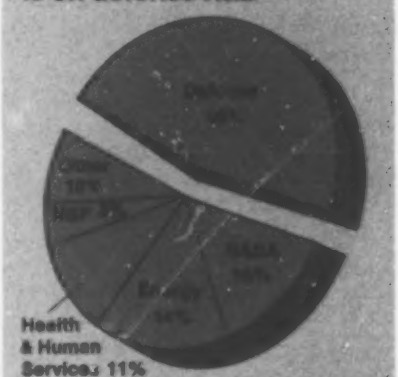
According to DOD, this substantial growth in R&D funding would both provide for choices in future weapons systems development and give it the capability to avoid any technological surprises. Areas to be emphasized in 1981 include materials research, environmental research, behavioral research relevant to combat, and high-energy lasers and particle beams as potential weapons.

The largest single DOD R&D obligation would go to the multiple-warhead, long-range M-X missile, whose funding would increase 131% to more than $1.5 billion to provide for full development of the system.

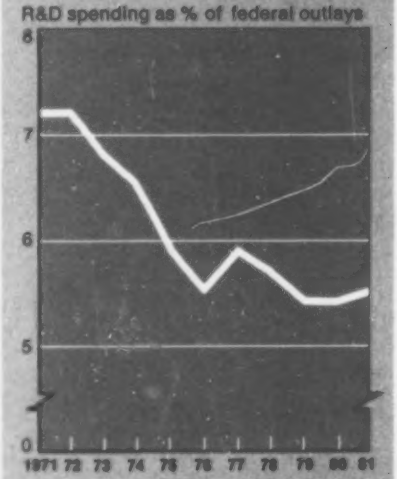
R&D funds grew only 13% in constant dollars since 1971



Greatest emphasis is on defense R&D



R&D funding holds steady at 5.5% of federal budget



C&EN staff photo

OMB director James McIntyre looks over budget at Government Printing Office

Glossary of budget terms

Authority. Permission to incur obligations, requiring either immediate or future payment, which will become available during the year. Appropriations on which Congress acts are the most common form of budget authority, allowing federal agencies to make payments out of the Treasury for specified purposes.

Deferral. Any executive branch action or inaction that delays the availability of budget authority for obligations. Deferrals may not extend beyond the end of the fiscal year and may be overturned at any time by either branch of Congress.

Fiscal year. Year running from Oct. 1 to Sept. 30. The fiscal year is designated by the calendar year in which it ends.

Obligations. Commitments made by federal agencies to pay out money for products, services, or other purposes, as distinct from the actual payments.

Outlays. Payments for obligations incurred under budget authority, generally made by issuance of checks by Treasury. Outlays during any fiscal year may be payments of obligations incurred in prior fiscal years or in the same fiscal year.

Recission. Enacted legislation canceling budget authority previously granted by Congress. Recissions proposed by the President must be approved by Congress within 45 days to become effective.

Other major projects involve developing antisatellite capabilities, antitank guided missiles, airfield attack and armor attack munitions, and communications and intelligence support for weapons systems.

Funding for some specific items in the DOD R&D budget includes $72 million for research on high-energy lasers, $52 million for materials research, about $45 million for chemical weapons defenses, almost $20 million for environmental quality research, and $5 million for drug and vaccine development.

The defense activities of the Department of Energy also are budgeted for a sizable increase in fiscal 1981. Although DOE's overall budget is slated for an increase of 7.6%, or $979 million, to $12.7 billion, its budget for defense activities would be up 14.5%, or $435 million, to $3.4 billion. The only program areas with an increase of less than 9% are inertial confinement fusion, funding for which would be up only 3.6% to $202 million, and materials production, whose funding would be up 2% to $522.5 million.

Some programs are in for quite large increases. For example, defense waste (i.e., nuclear) management funding would increase 23% to $349.7 million and the weapons program budget would rise 19%, to $2 billion, with the largest part of the increase, 71%, going for weapons production and surveillance.

DOE's civilian R&D program did not fare so well as its defense program. The agency's funding authorities (which are equivalent to other agencies' obligations) for civilian R&D programs are budgeted to increase only $118.3 million, or 3%, to $4.2 billion. Outlays would decrease $4.6 million, a scant 0.1%, to $4.2 billion.

But although the budget would stay fairly constant, there are a number of increases and decreases in funding for various DOE R&D programs. The major decrease is for DOE's nuclear programs, which would be cut 28%, or $305 million, to $768.2 million. Cuts of $377.6 million in the breeder reactor and $11 million in the convertor reactor budgets are slightly offset by increases of $78 million for the commercial waste management program and of $4.6 million for advanced nuclear systems. The only other decrease scheduled in the DOE budget is a relatively minor one for conservation R&D funding, which would be down 5.3% to $269.5 million.

The fossil energy budget, on the other hand, is a big winner. After having been cut about 3% in fiscal 1980, it is scheduled for a 31% increase in fiscal 1981, to $1.1 billion—perhaps a reflection of the new emphasis on synthetic fuels. The fossil energy budget provides for, among other things, $23 million to continue development of atmospheric fluidized-bed combustion systems, $97 million to continue R&D on technologies to increase energy conversion efficiency in fuel cells and magnetohydrodynamics, and $65 million for basic research on and development of advanced coal conversion technologies.

The other DOE R&D programs are scheduled for increases ranging from a modest 1% for solar energy technology to 13.4% for basic energy sciences. The proposed authorities of $257.3 billion for the basic energy sciences program include $74.4 million for chemical sciences, an increase of 14.5% over fiscal 1980 levels. Chemical sciences initiatives include solar photoconversion, catalysis, and combustion research.

The National Aeronautics & Space Administration once again would become the largest federal spender of civilian R&D dollars in 1981, after being surpassed briefly by the Department of Energy in 1980. Under the budget proposal, funds for conducting R&D would be up $463 million, or 11.3%, to $4.6 billion. NASA's total budget would be up 9% to $5.7 billion.

The largest item in NASA's R&D budget is, of course, the space shuttle. Funded at just under $1.9 billion for 1981, it is the largest single R&D project in the entire U.S. budget. The 1981 funding would support the initial manned orbital flight of the shuttle, now expected in late 1980 and a shuttle production schedule that could meet civilian and military launch requirements.

The 1981 budget also includes funds for three new projects. One of these is a gamma-ray observatory, scheduled to be launched in 1985. The observatory, with first-year funding of $19 million, is expected to increase significantly basic knowledge of phenomena such as quasars and black holes by studying their gamma-ray emissions.

The other new projects are an operational land observing system, funded at $16 million, and a national oceanic satellite system, to be developed jointly by the National Oceanic & Atmospheric Administration and DOD to obtain oceanic data by remote sensing from space. First-year funding for this project is set at about $6 million.

Development is continuing on projects approved in previous years. The most important is the space telescope, with funding increased almost 6% to $119 million. The tele-

scope will be able to observe objects as far away as 60 billion light years from Earth without the obscuring effects of Earth's atmosphere. Also, the international solar polar project would get a big boost with a proposed 72% increase in funding for 1981, to about $83 million. This project, expected to launch in 1983, will be the first ever to study the sun's polar regions. Finally, the Galileo mission to Jupiter has been restructured as a dual shuttle project planned for launch sometime in 1984. Its funding would be cut almost in half for 1981, to $63 million.

In aeronautics research, programs would continue to develop greater fuel efficiency, safety, and reduced noise for aircraft. New initiatives are being proposed for advance turboprop technology that has the potential of increasing fuel efficiency more than 20% over current designs.

The 1981 budget for the Department of Health & Human Services (formerly part of Health, Education & Welfare) is slated to increase 6% over fiscal 1980 obligations to a total of $4.0 billion. Of this, $1.8 billion would be for basic research.

Quite a hefty portion of the $4.0 billion, however, would go to the National Institutes of Health to support a wide range of biomedical and behavioral research. NIH's 1981 R&D budget of $3.7 billion, up from $3.6 billion in 1980, would focus on basic and applied research in nutrition, genetics, diabetes, radiation and other environmental hazards, aging, and senile dementia.

Included in NIH's budget request are sufficient funds, HHS says, to ensure the continuity of national biomedical research by stabilizing at 5000 the number of new and competing research grants to individual researchers or teams. Also included in the 1981 NIH budget is $92 million to expand the National Toxicology Program, headed by David Rall, director of the National Institute of Environmental Health Sciences.

Among NIH research efforts to be supported in fiscal 1981 are studies to elucidate the role of nutrition in cancer, cardiovascular disease, childhood development, and aging; research into the causes, treatments, and prevention of diabetes; and research on tropical diseases, a new thrust for NIH.

HHS R&D funds also are distributed to, among others, the Food & Drug Administration, the Center for Disease Control, and the National Institute for Occupational Safety & Health. FDA's fiscal 1981 budget of $362 million, an increase of $34 million over fiscal 1980, includes $25 million to build new laboratory facilities for the Bureau of Foods and the Bureau of Drugs. FDA's R&D funds of $67 million in fiscal 1981 will go toward research in support of its regulatory responsibilities, including research on the biological effects of toxic substances at its National Center for Toxicological Research.

The Center for Disease Control, charged with health protection and disease prevention, has fiscal 1981 obligations proposed at $391 million, up $25 million over fiscal 1980. About $31 million would go into coordinating responses to state requests for help in bringing environmental emergencies, such as Love Canal and Three Mile Island, under control and in studying their effects on human health.

A small part of the center's R&D obligations of $95 million for fiscal 1981 would be devoted to research on health services, health statistics, and health-care technology assessments. Nevertheless, fully 87% of its R&D budget is slated for research undertaken by the National Institute for Occupational Safety & Health to develop criteria on toxic materials and other occupational hazards. A prime NIOSH thrust is planned for basic research in occupational safety and health.

National Science Foundation officials are once again more than satisfied with the President's budget request. Not only would NSF's total budget be up more than 15% to $1.1 billion, but its research and related activities budget would pass the billion-dollar mark for the first time, riding a 17.7%, $159 million increase. Obligations for NSF science education programs would be up almost 10%, or $7.5 million, to $85.7 million.

The budget proposal shows that NSF will be playing a major role in the Administration's efforts to stimulate industrial innovation. Funding for NSF's industry/university cooperative research program would be up a whopping 185% to $20 million. And funding aimed at stimulating small business innovation and industrial technology would rise 147% to $18.2 million, with $13 million targeted for highly innovative research in small businesses.

A new effort by NSF in fiscal 1981 would be a $14.3 million program to upgrade university research laboratories, many of which have outdated facilities. This is planned as a matching grant program, with academic institutions matching federal funds from nonfederal sources. NSF also plans to initiate a 10-year, estimated $700 million ocean margin drilling program intended to produce geological, geophysical, and other information. The program would be funded jointly by industry and government.

But the new initiatives don't mean that the budget request has slighted any of NSF's ongoing programs. Obligations for basic research, which accounts for 83% of NSF's efforts, would be up 17% to $951.5 million. Obligations for applied research would increase more than 25% to $93.4 million. Although funding for all the directorates would increase at least 9%, the largest increase would be for the engineering and applied sciences directorate, whose budget would rise 22% to $137 million. Funding for chemical and process engineering is slated for a 20% increase to $16.7 million.

The mathematical and physical sciences directorate would get the next largest increase, 16.7%, with obligations budgeted to rise to $264.2 million. The directorate would, among other things, support frontier research in chemistry, materials research, and computer science related

Basic research funding up 12% to $5 billion

$ Millions	1981[a]	1980[a]	% change 1980–81
Health & Human Services	$1840	$1728	6.5%
NSF	952	814	16.9
Energy	593	523	13.4
NASA	581	535	8.6
Defense	523	431	21.3
Agriculture	324	289	12.1
Interior	78	76	2.6
Smithsonian	44	39	12.8
Commerce	36	28	28.6
Education	25	20	25.0
EPA	19	14	35.7
Others	58	32	81.2
TOTAL	$5073	$4529	12.0%

a Estimates. **Note:** Obligations.

Defense R&D funds soar with 20% increase

$ Millions	1981[a]	1980[a]	1979[b]
Tactical programs	$5,715	$5,371	$4,984
Strategic programs	3,267	2,231	2,078
Technology base	2,656	2,150	1,976
Program management and support	2,254	1,788	1,693
Intelligence and communication	1,530	1,114	748
Advanced technology development	612	619	542
Other	532	508	441
TOTAL	$16,566	$13,781	$12,462

a Estimates. b Actual

The total federal R&D package

Agency by agency R&D funding breaks down like this

$ Millions	Obligations			Outlays		
	1981[a]	1980[a]	1979[b]	1981[a]	1980[a]	1979[b]
Defense	$16,565	$13,781	$12,463	$15,169	$13,253	$11,454
NASA	5,617	5,114	4,411	5,277	4,858	4,064
Energy	5,106	4,919	4,588	5,068	4,871	4,413
Health & Human Services	4,011	3,784	3,485	3,661	3,428	3,068
NSF	1,056	897	805	964	853	775
USDA	786	743	670	670	652	611
EPA	445	415	410	413	384	337
Interior	415	419	405	413	396	393
Labor	385	279	137	374	277	102
Transportation	379	353	357	348	332	340
Commerce	379	371	334	394	347	305
NRC	228	204	157	204	182	141
Education	156	146	164	154	151	128
Veterans Adm.	142	134	130	135	126	117
Other	465	397	368	456	368	331
TOTAL	$36,135	$31,956	$28,894	$33,720	$30,478	$26,579

a Estimates. b Actual.

Federal R&D funds to universities would jump about 10%

$ Millions	Obligations			Outlays		
	1981[a]	1980[a]	1979[b]	1981[a]	1980[a]	1979[b]
Health & Human Services	$2244	$2097	$1932	$2075	$1896	$1691
NSF	794	670	602	725	637	580
Defense	443	401	364	416	376	341
Energy	364	323	292	361	320	281
USDA	236	223	206	215	194	169
NASA	174	163	144	157	147	127
Other	335	316	292	296	257	243
TOTAL	$4590	$4193	$3832	$4245	$3827	$3432

a Estimates. b Actual.

Funding for R&D facilities would fall slightly

$ Millions	Obligations			Outlays		
	1981[a]	1980[a]	1979[b]	1981[a]	1980[a]	1979[b]
Energy	$1257	$1309	$822	$1179	$1032	$690
Defense	445	369	270	383	306	236
NASA	120	156	148	163	155	133
Health & Human Services	47	46	51	42	66	74
USDA	37	38	23	42	36	22
Other	93	113	99	98	134	100
TOTAL	$1999	$2031	$1413	$1907	$1729	$1255

a Estimates. b Actual.

to microstructures; increase support for the Materials Research Laboratories by $2.8 million to $22.2 million; and increase support for research project instrumentation, including chemistry department equipment, $5 million to a total of $26.2 million.

Obligations for chemical research would climb 15.8% to $59.5 million. The $8 million increase is spread fairly evenly among all the chemistry program areas, with funding in each increasing 14 to 16%.

Research funding would be up this year at the Department of Agriculture, too, 5.8% from $743 million in 1980 to $786 million in 1981. About 75% of the $43 million is earmarked for basic research, including expansion of agriculture and resource surveys through satellite remote sensing.

The Agricultural Research and Cooperative Research programs of USDA's Science & Education Administration combined would get 77%, or about $606 million, of the department's R&D funds. Agricultural Research projects, funded at $403 million, would emphasize integrated pest management, human nutrition and health, aerospace technology, and basic research related to food production.

Cooperative Research programs would receive an additional $13 million for 1981, for total funding of $203 million. This program administers funds for the state agriculture experiment stations and other institutions doing comparable research. It also would receive a very large increase for its competitive grants project, 56%, raising it to $25 million. This project funds basic research in such areas as nitrogen fixation and the ability of humans to utilize vitamins and minerals.

Also, legislation has been proposed to authorize $50 million for improvement of research facilities at the predominately black 1890 colleges (established that year to aid blacks) and Tuskegee Institute. The 1981 funding includes $5 million for the federal portion of the first year of this proposed five-year program. State governments would be required to provide funds matching the federal payment.

EPA is swamped with work and its budget is lean, says William Drayton Jr., assistant administrator for planning and management. And in fiscal 1981 the agency will be writing and enforcing regulations for hazardous wastes under the Resource Conservation & Recovery Act, for synthetic fuel production, and for hazardous waste cleanup under superfund legislation now pending in Congress.

To perform the R&D undergirding the standards and regulations, EPA would obligate $445 million in 1981, up a mere 6.7% from 1980. The major growth areas have shifted to two chemical control programs—hazardous waste and toxic substances R&D. Funding for the hazardous waste research program would increase a whopping 86% in 1981 to $26 million, and toxic substances research funding would rise 32% to $47 million in 1981.

The largest single R&D program in EPA, however, is energy. This research effort, which would be funded at $108 million, a 6% increase, in 1981, would focus on improving the standards-setting data for synthetic fuel installations.

Of the remaining major research efforts, air research would receive $70 million, up 5%, and water-quality re-

How the agencies fare

NSF budget posts a 15.5% gain to well over billion-dollar mark . . .

$ Millions	1981[a]	1980[a]	1979[b]
Mathematical and physical sciences	$264.2	$226.4	$208.9
Astronomical, atmospheric, earth, and ocean sciences	241.3	217.9	211.6
Biological, behavioral, and social sciences	182.0	166.5	154.7
Engineering and applied science	137.0	111.6	109.9
Science education	85.7	78.2	80.0
Antarctic program	63.4	55.8	51.1
Program development and management	60.8	60.6	54.7
Cross directorate programs	52.0	25.5	16.8
Scientific, technological, and international affairs	26.8	26.1	23.6
Ocean drilling programs	27.3	19.5	11.6
Special foreign currency program	5.5	5.5	4.0
TOTAL	$1149.0	$993.8	$926.9

a Estimate. b Actual. Note: Obligations.

. . . with funding for chemical research up 16% to almost $60 million

$ Millions	1981[a]	1980[a]	1979[b]	% change 1980–81
Materials research	$78.6	$68.5	$62.4	14.7%
Ocean sciences	76.0	66.6	62.4	14.1
Physiology, cellular and molecular biology	74.8	67.2	62.3	11.3
Applied sciences	74.4	59.3	61.0	25.5
Physics	73.5	63.4	61.7	15.9
Atmospheric sciences	71.1	63.2	58.1	12.5
Engineering	62.6	52.5	48.9	19.2
Astronomical sciences	60.2	57.0	59.2	5.6
Chemistry	58.5	51.4	45.2	15.8
Environmental biology	40.7	37.7	33.9	8.0
Behavioral and neural sciences	36.7	35.4	33.1	9.3
Mathematical sciences	29.3	24.9	22.8	17.7
Earth sciences	27.9	25.3	24.9	10.3
Social and economic sciences	27.8	26.2	25.4	6.1
Computer research	23.3	18.3	16.8	28.0
TOTAL	$818.4	$716.8	$679.1	14.2%

a Estimate. b Actual. Note: Obligations.

NSF funding for chemical research is broken down like this

$ Millions	1981[a]	1980[a]	1979[b]
Structural chemistry and chemical thermodynamics	$12.37	$10.66	$9.44
Chemical dynamics	11.50	9.93	8.47
Quantum chemistry	9.59	8.32	7.40
Synthetic organic and natural products chemistry	7.14	6.16	5.56
Chemical analysis	6.65	5.78	5.14
Synthetic inorganic and organometallic chemistry	6.62	5.81	5.16
Chemical instrumentation	5.57	4.76	4.07
TOTAL	$59.44	$51.42	$45.24

a Estimates. b Actual. Note: Obligations.

EPA's 1981 R&D budget increases 8%

$ Millions	1981[a]	1980[a]	1979[b]
Energy	$107.6	$101.4	$112.6
Air	70.2	66.6	52.0
Water quality	60.0	65.2	65.7
Toxic substances	36.9	27.9	16.8
Drinking water	27.5	22.6	17.6
Solid/hazardous waste	26.4	14.2	8.5
Interdisciplinary	22.8	22.7	19.7
Pesticides	9.4	13.0	12.7
Program management	4.7	4.6	4.4
Radiation	3.2	3.1	1.8
TOTAL	$368.7	$341.7	$311.8

a Estimates. b Actual. Note: Obligations.

NASA's R&D budget rises a solid 11%

$ Millions	1981[a]	1980[a]	1979[b]
Conduct of R&D	$4571	$4106	$3477
Space shuttle	1873	1886[c]	1638
Space flight operations	810	447	300
Physics and astronomy	439	337	283
Space applications	382	332	275
Space tracking and data systems	359	332	300
Astronautical research and technology	290	308	264
Planetary exploration	180	220	182
Space research and technology	115	116	107
Expendable launch vehicles	56	71	74
Life sciences	50	44	40
Technology utilization	13	12	9
Energy technology	4	3	5
Research and program management	1047	1008[d]	934
Construction of facilities	120	156	148
TOTAL	$5738	$5270	$4559

a Estimates. b Actual. c Includes proposed supplement of $300 million. d Includes proposed supplement of $46.3 million to cover 1979 salary increases. Note: Obligations.

NIH total funds increase a modest 3%

$ Millions	1981[a]	1980[a]	1979[b]
National Institutes	$3315	$3199	$2934
Cancer	1006	1004	936
Heart, Lung & Blood	548	529	510
Arthritis, Metabolism & Digestive Diseases	366	343	303
General Medical Sciences	332	313	277
Neurological & Communicative Disorders & Stroke	250	243	212
Allergy & Infectious Diseases	228	217	192
Child Health & Human Development	218	210	197
Eye	117	113	105
Environmental Health Sciences	102	88	81
Aging	75	70	56
Dental Research	71	69	65
Research resources	190	175	159
National Institute for Occupational Safety & Health	83	81	57
National Library of Medicine	47	47	41
Office of the Director	35	35	31
Research facilities	32	42	49
John E. Fogarty Center	10	10	9
TOTAL	$3712	$3589	$3280

a Estimates. b Actual. Note: Obligations.

Department of Energy's civilian R&D budget up slightly to $4.2 billion

$ Millions	Authorities 1981	Authorities 1980	Outlays 1981	Outlays 1980
Fossil energy	**$1123.5**	**$858.4**	**$897.7**	**$891.0**
Coal	**957.8**	**669.6**	**726.0**	**701.1**
Liquefaction	523.9	250.5	329.7	214.0
Gasification	148.5	126.0	118.0	180.2
Combustion systems	68.5	57.5	61.0	74.8
Advanced research	59.5	51.4	49.6	60.8
Mining R&D	46.5	68.9	43.4	66.5
Heat engines and heat recovery	43.4	50.5	45.1	63.0
Environmental control	42.5	38.3	49.7	24.1
Fuel cells	25.0	26.5	29.5	17.7
Petroleum and natural gas	**93.7**	**96.2**	**91.9**	**109.2**
Enhanced recovery	50.2	58.8	58.8	74.9
Oil shale	36.1	28.3	24.1	29.2
Advanced technology	7.4	9.1	9.0	5.1
Magnetohydrodynamics	**72.0**	**92.6**	**79.8**	**80.7**
Nuclear	**768.2**	**1073.3**	**880.0**	**1110.9**
Breeder reactor systems	**372.8**	**750.4**	**475.7**	**778.4**
Liquid metal	299.8	614.9	375.7	621.3
Water cooled	61.0	60.0	68.0	69.0
Fuel cycle R&D	12.0	30.0	23.0	33.1
Gas cooled	—	26.0	9.0	26.0
Thermal reactor fuel cycle	—	19.5	—	29.0
Commercial waste management	**298.9**	**220.0**	**295.6**	**216.9**
Converter reactor	**53.5**	**64.5**	**65.0**	**70.3**
Thermal reactor	48.5	57.0	53.0	51.1
Advanced reactor systems	5.0	7.5	7.7	6.2
Gas-cooled thermal reactors	—	—	4.3	13.0
Advanced nuclear systems	**43.0**	**38.4**	**43.7**	**45.3**
Space & terrestrial applications	40.0	36.4	40.7	41.0
Systems evaluation	3.0	2.0	3.0	4.3
General sciences	**521.8**	**470.9**	**506.9**	**460.1**
High-energy physics	358.0	324.5	349.3	315.6
Nuclear physics	115.2	104.4	111.7	105.7
Life sciences research	48.6	42.0	45.9	38.8
Magnetic fusion	**400.5**	**352.5**	**460.8**	**372.3**
Solar	**386.5**	**384.3**	**383.9**	**384.5**
Photovoltaics	140.0	147.0	118.5	131.5
Thermal power system	117.5	121.0	141.4	135.7
Wind energy systems	80.0	63.4	74.7	63.4
Ocean systems	39.0	46.0	39.3	47.0
Solar Energy Research Institute	10.0	6.9	10.0	6.9
Conservation	**269.5**	**283.9**	**256.0**	**237.3**
Transportation	113.0	117.5	111.6	100.0
Buildings and community systems	97.6	106.1	93.1	87.4
Industrial	58.9	60.3	51.3	49.9
Basic energy sciences	**257.3**	**226.8**	**262.0**	**242.4**
Materials sciences	99.9	97.0	106.9	108.2
Chemical sciences	74.4	65.0	75.2	68.0
Nuclear sciences	34.8	32.0	33.8	32.7
Engineering, mathematical	30.7	21.3	29.3	21.8
Biological energy research	9.2	6.3	8.8	6.4
Advanced energy projects	8.3	5.2	8.0	5.3
Environmental R&D	**250.0**	**225.3**	**242.2**	**219.8**
Geothermal	**142.0**	**138.4**	**142.6**	**134.2**
Energy storage	**70.8**	**65.0**	**73.2**	**62.0**
Biomass	**63.0**	**56.0**	**60.1**	**55.5**
TOTAL	**$4253.1**	**$4134.8**	**$4165.4**	**$4170.0**

Note: All numbers are estimates.

search would receive $60 million, down 8%, in 1981. The $27 million (up 21%) allocated to drinking water research in 1981 would zero in on improving the ability of small communities to meet national drinking water standards.

Interdisciplinary research, designed to identify emerging problems before they reach the crisis stage, would receive nearly $23 million in 1981, very slightly more than in 1980. Initiatives in this category would focus on carcinogens, environmental benefits, biological monitoring, and integrated assessments of emerging or latent environmental problems. EPA also plans to contribute funds to interagency research on acid rain.

Even in this "restrained" 1981 budget, basic research efforts at the Department of Commerce will not be slighted, assistant secretary for administration Elsa A. Porter says. Indeed, Commerce's R&D obligations for fiscal 1981 would increase a modest 2% to $379 million, but obligations for basic research would increase almost 29% to $36 million. Of the total R&D funds, the National Bureau of Standards would receive all of the $8 million increase, boosting its budget to $84 million, primarily to expand its basic measurements and standards research. A major NBS effort will be development and commercialization of very-large-scale integrated circuits.

The National Oceanic & Atmospheric Administration would obligate $218 million, the same level as fiscal 1980, for R&D to improve environmental prediction and warning capabilities, among other things. New NOAA initiatives would include development of advanced weather radar equipment to improve severe weather warnings, multispecies (fisheries) management research, and an ocean-heat-storage-field experiment for climate research.

With DOD, NOAA plans to develop a National Oceanic Satellite System. To this end, NOAA's 1981 budget would obligate $6.4 million, about one quarter of the 1981 cost. NOAA also has been designated the lead federal agency for operating civilian satellites, which means that the experimental LANDSAT system has now been transferred from NASA to NOAA. NOAA deputy administrator James (Bud) Walsh says that the agency intends to develop the LANDSAT system to the commercial stage.

Commerce also would receive new responsibility for industrial innovation. Its programs in this area, which draw from a budget request of $10.2 million, are part of a larger federal effort to encourage industrial innovation, Porter says. Commerce has asked for $3 million in fiscal 1981 to enhance the transfer of federal and foreign technology, $5.2 million to set up three nonprofit centers for "generic technology" to be financed jointly with private industry, and $1.9 million "to develop and evaluate operational strategies," Porter adds. □